

Biosafety Cabinet Maintenance & Use Instructions

Purpose

To provide information about biosafety cabinet equipment available to students, faculty, and support staff.

Scope

The scope of the procedure is the installation, maintenance, performance, testing, training, and use of biosafety cabinets. Relevant equipment is installed in laboratories.

Responsibilities

A. Environmental Health & Safety (EHS)

1. EHS will provide safety training and information as required.
2. EHS will contract with a vendor to perform annual inspections for safety equipment and test as required. The vendor shall provide test data to EHS for recordkeeping.
3. EHS will contract with a vendor to perform maintenance on equipment as required.

B. Managers & Principal Investigators (Supervisors)

1. Supervisors will ensure that access to equipment is maintained.
2. Supervisors will provide training to personnel.
3. Supervisors will ensure that equipment is tested by personnel.

C. Laboratory Personnel

1. Laboratory personnel will perform qualitative checks as required.
2. Laboratory personnel will receive training on the equipment locations and use methods.
3. Laboratory personnel will report equipment issues to EHS.

Introduction

Biological safety cabinets or biosafety cabinets (BSCs) are exposure control devices used to protect personnel from potentially infectious aerosols while conducting work. BSCs are the primary means of containment for working with infectious microorganisms in laboratories on campus, a form of engineering control creating a barrier between the user and the hazard. Class II BSCs, the most common cabinets used in laboratories, are designed to provide protection for personnel, products (samples), and the environment. Biological safety cabinets shall meet minimum standards for cabinet classifications in NSF/ANSI 49-2016 for personnel, environmental, and product safety and shall be listed and identified by the NSF seal.

Biological safety cabinets should be used when performing procedures that might cause splashing, spraying, or splattering of droplets. BSCs should also be used for the initial processing of clinical specimens when the nature of the test requested or the likely presence of an agent readily transmissible by infectious aerosols (e.g., *M. tuberculosis*, *M. morbillivirus*), which

causes tuberculosis (TB) and measles, respectively, or when BSC use is indicated to protect specimen integrity (e.g. Class II).

One commonality to all classes of biosafety cabinets is the use of high efficiency particulate air (HEPA) filters, a pleated air filter that captures contaminants by having air drawn through them. This type of filter removes airborne particles of 0.3 microns (or μm) in diameter, the most penetrating particle size, with an efficiency of 99.97%. Particles of this size include animal dander, bacteria, dust, mold spores, and pollen. It may be more effective against particles that are larger (e.g. hair, larger versions of the prior examples) or smaller (e.g. viruses) per EPA. While effective for aerosols such as particulates, fumes, and droplets, the filters do not remove gases or vapors, which are much smaller. The BSC uses this filtered air to maintain clean air over the experimental materials and equipment within the enclosure, which prevents cross-contamination. Filters will have to be changed periodically to maintain this capability.

Regular cleaning/disinfection of biosafety cabinets prevent the accumulation of dust and microbiological contaminants that may affect the user, environment, and product, but also affects the efficacy or efficiency of the BSC itself. They require regular maintenance and certification from an accredited technician to ensure that it protects this protection. Each cabinet should be certified when it is installed, each time it is moved or repaired, and at least annually. The Department of Environmental Health & Safety (EHS) manages annual certification of all biological safety cabinets on campus. Annual certifications are a requirement under the NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules.

Classification of Biosafety Cabinets

There are three classes of biosafety cabinets commercially available for use: Classes I, II, and III. The higher the class of BSC, the greater the protection for personnel, products, and the surrounding environment. Classes I and II cabinets are appropriate for work with BSL-1, BSL-2, and BSL-3 pathogens. Class I BSCs protect personnel and the environment, but do not protect experimental materials. They draw room air inward past the sash, without filtration, which protects the worker from the hazardous material in the cabinet. The exhausted air is then drawn through a HEPA filter, which is then released to the laboratory or further exhaust via hard ducting, to the environment.

Class II BSCs provide protection for personnel, environment, and the product (experimental materials). Room air is drawn inward past the sash, which provides personnel protection. However, this air is then drawn into the front intake grille of the cabinet (protecting the product from unfiltered air), eventually cleaned by a supply HEPA filter, and is reintroduced to the experimental material with downward laminar flow of the HEPA-filtered air (providing additional product protection). The cabinet air is filtered continually. In addition to filtered air returning to the cabinet, this air passes through the exhaust HEPA filter, which is either released to the laboratory or ducted to external exhaust in the facility.

Class II BSCs are further classified into types based on the inflow air velocity, exhaust method, and circulation mode: Types A1, A2, B1, B2, and C. Exhaust air is typically recirculated back into the laboratory in Type A cabinets, and it leaves via exhaust duct to the external environment in Type B cabinets, while Type C cabinets may toggle between these two modes. In Type A cabinets, about 70% of the air is recirculated to the cabinet and the remaining approximately 30% is exhausted to the laboratory. Type A1 BSCs differ from Type A2 in the

minimum inflow velocity of air ($A1 \geq 75$ fpm, whereas $A2 \geq 100$ fpm); Type A2 may also be configured to handle minute amounts of chemicals with nonhazardous fumes, and it may also be hard ducted to exhaust to the external environment.

Type B1 cabinets are designed to handle work with minute amounts of toxic chemicals. A portion of the contaminated air (typically more than half) is exhausted to the environment with a single pass of air through the cabinet and HEPA filtered while the remaining portion of filtered air is recirculated back to the cabinet. The downflow of recirculated air is closer to the front while exhaust to hard duct is in the rear. Type B2 cabinets are safe for use with volatile chemicals and exhaust 100% of their air after filtration to the external environment. Type C cabinets are flexible in that they may recirculate air or remove contaminated air by external exhaust, allow for chemical handling, and maintain active protection during an exhaust failure, whereas type B air does not move in this state, causing a hazardous condition.

Class III BSCs (or Class III gloveboxes) were designed for work with highly infectious agents that require BSL-4 containment, which provides the best protection for personnel, products, and the environment. This style of cabinet is gas-tight with a non-opening window with glove ports where rubber gloves allow for the manipulation of materials in the cabinet. Air is filtered through one HEPA filter as it enters the cabinet, and through two HEPA filters before it is exhausted externally.

Note: Horizontal laminar flow clean air benches are not biosafety cabinets. They do not provide protection to personnel or the environment, only the product. They should never be used when handling potentially infectious materials or doing any microbiological work, as they are not a substitute for biosafety cabinets.

Parts of a Biosafety Cabinet

The standard biosafety cabinet used (Class II, Type A2) has several important parts for its operation (see Figure 1 below): a control panel, downflow fan and exhaust blower, front intake grille, HEPA filters, rear exhaust/slot, a sash, and a work surface. At the front or face, the sash is a window used primarily to protect users and their environment from hazardous external air contaminants, protect the products (or experiment) from external air contaminants, and control airflow to the cabinet. It may also offer some protection against splashes and should be kept as low as necessary to do work. Above the sash is the control panel, which houses the off/on function, light utilities, and displays information about air velocities, hours of use, filter life meter, or alarms/alerts important for the user to investigate.

Within the cabinet is the work surface where all apparatus and microbiological work is done. At the edges of the interior are the front intake grille, used to prevent escape of aerosols, and the rear exhaust/slot, which maintains airflow through the cabinet and prevents build-up of aerosols, each part directing contaminants away from the work area and into the exhaust. Each of these parts will have a built-in screen to prevent light objects (e.g. paper) from being drawn into them and causing turbulence or blockage, reducing airflow and energy efficiency. The contaminated air, such as dust, light fumes from chemicals (e.g. disinfectants), microbes, and any other work done in the cabinet, are diluted and moved by room air that enters through the sash and by filtered air from the cabinet. Contaminants are drawn into the exhaust, from the intake grille under the work surface and combined with the rear exhaust into a rear plenum, up to the exhaust blower, through the downflow fan, and finally captured by HEPA

filters. The fan and blower are parts used to move contaminated air while the HEPA filters clean it. Filtered air is released back to the interior of the BSC (downward through the supply HEPA filter) and is also recirculated to the laboratory (upward through the exhaust HEPA filter).

Below the work surface is a drain tray or catchment that captures spills on the work surface, preventing contamination of lower, inaccessible areas of the BSC, emptied by a drain valve. Also below the cabinet are the legs of the unit, which are used to support the cabinet, attain the appropriate height to do work, and provide stability. Here, there may also be foot support attached for user comfort and ergonomic positioning to complete a built-in armrest at the front of the unit at the sash.

In addition to these features, BSCs are equipped with utilities such as a chamber light (fluorescent or LED) for visibility, germicidal ultraviolet (UV) lamps for sterilization, electrical outlets for apparatus, valves for gases (including natural gas) or vacuum, and access ports at the side of the cabinet for hoses or cables/wiring used to reduce interference with the sash and airflow. **Note:** Vacuum nozzles shall always be used with a vapor trap (e.g. cold trap, liquid trap, filter) or equivalent device to prevent harm to workers and to prevent contamination and damage to the vacuum line and related system.

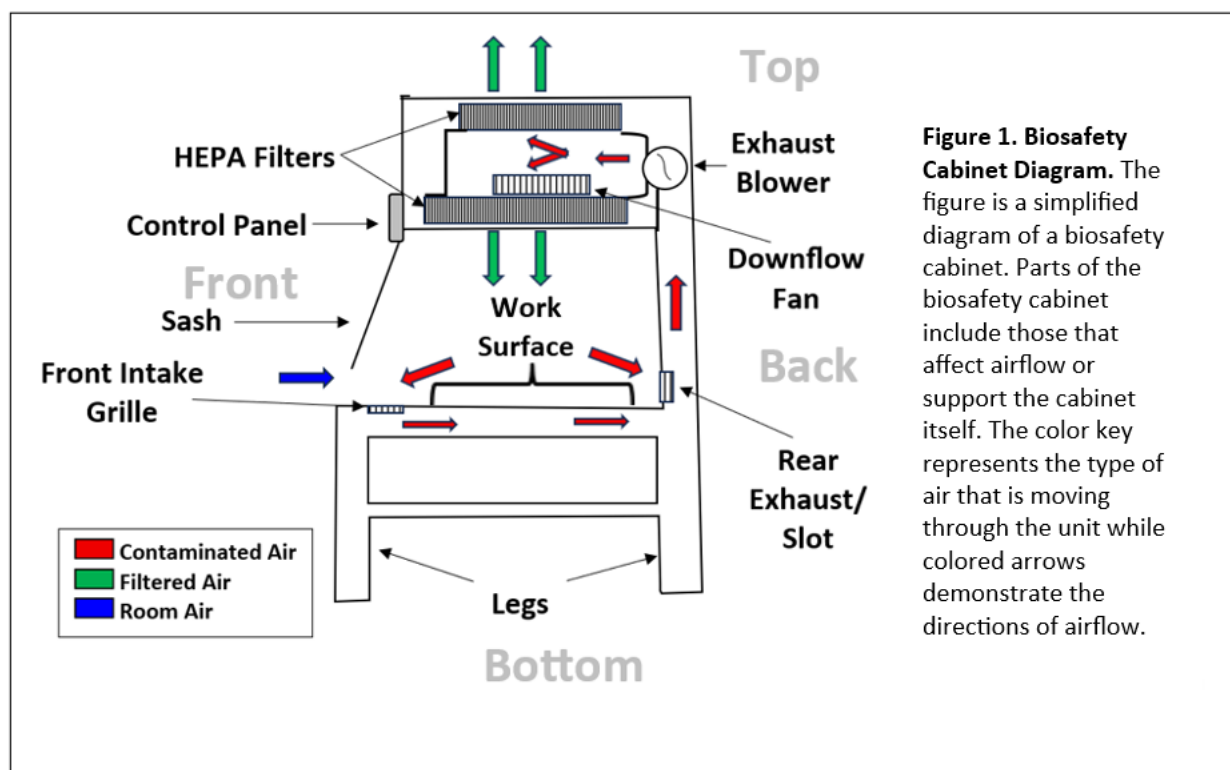


Figure 1. Biosafety Cabinet Diagram. The figure is a simplified diagram of a biosafety cabinet. Parts of the biosafety cabinet include those that affect airflow or support the cabinet itself. The color key represents the type of air that is moving through the unit while colored arrows demonstrate the directions of airflow.

Biosafety Cabinets vs. Chemical Fume Hoods

Biosafety cabinets (BSCs) and chemical fume hoods (FHs) are exposure control devices used for work with hazardous materials. Both devices are examples of local exhaust ventilation which have a similar configuration in box-style containment with a front-facing window (sash) and exhaust features at the rear, often are made of stainless-steel construction, and include additional utilities such as overhead lamps for visibility, electrical outlets, and service valves for

gas or vacuum. Personnel are recommended to always keep their bodies (except hands and arms) outside of the devices during work and to keep work within reach but several inches inside the sash. Many of the same hindrances to airflow from turbulence or obstruction within these devices from the large size or quantity in equipment or supplies are shared. Testing or certification at least once annually is recommended for both types of equipment. The similarities of the devices differ from here.

Standard chemical fume hoods are used for working with chemicals (e.g. metals, gases, liquid chemicals) but are generally not acceptable for experiments involving biological materials or microbial work. Hoods do not filter airborne wastes prior to exhausting to the environment, so microbes may find a niche and grow within ductwork. Biosafety cabinets, in contrast, are used for microbiological work and are equipped with HEPA filters (and in some cases, ultraviolet lamps) for the purpose of controlling the hazard from infectious materials. BSCs involve styles of equipment that are typically not suitable for work with high volumes of chemicals or highly hazardous chemicals, which may be exhausted back to the laboratory, as recirculation of some filtered air is typical. In addition, disinfection is a regular feature of BSC use and care in reducing the spread of pathogens is an additional step than what may be required in using a fume hood. There are more parts to a BSC which may fail and lead to alarm or inoperable status.

Lastly, in fume hoods, the vapors, fumes, and dust from materials within the hood and any from room air are exhausted to the outdoors, protecting the user and the laboratory environment. Biosafety cabinets protect samples from airborne impurities from air entering the cabinet (room air) by drawing it into the front intake grille and preventing the escape of aerosols by drawing them into its HEPA filters, protecting the user, laboratory environment, and the experimental samples within the cabinet.

Procedure

A. Installation & Performance

1. Upon installation, a biosafety cabinet must be certified.
2. If the biosafety cabinet has been moved from its current location, or disassembled and reassembled in another location, the equipment must be re-certified.
 - a) In the case of disassembly, re-assembly, and/or movement of the unit to another space or room:
 - i. *The unit shall be decontaminated, regardless of the claim that it has never been used (surface disinfection at the very least),*
 - ii. *The unit shall be carefully moved, always keeping it upright, and*
 - iii. *The unit, fully assembled, shall be recertified in its new space to ensure that it has not been damaged or compromised.*
3. EHS must be involved in the installation, move, or any modification of a biosafety cabinet, or related utilities and infrastructure.
 - a) Laboratory personnel may request modification to infrastructure through the Building Manager and Facilities Management.

4. Performance Requirements

- a) Placement of equipment should not be close to doors, windows, or HVAC ceiling vents such as supply air diffusers, exhaust, or return air grilles. Drafts and wayward air movement can affect the efficiency of the ventilation for the unit.
- b) Airflow shall be sufficient to remove contaminants.
- c) The standard biosafety cabinet will be installed such that the base height for the unit is 30-32 inches from the floor.
- d) Room air is to be used for removal of airborne hazards within the cabinet. Air is recirculated back to the room after being filtered through the unit's HEPA exhaust filter.
- e) Biosafety cabinet inflow velocity must operate at least 100 fpm.
- f) Sash adjustment should be easy as the sash should move freely and vertically.

5. Parts & Assembly

- a) Only qualified individuals or vendors will assemble and disassemble biosafety cabinets and related parts.
- b) Sash stops for biosafety cabinets should be used to properly set sash in place.
- c) The sash is an important defense against airborne contaminants, splashes, or other exposure to contaminants and must be able to rest on any installed stops easily. The sash should be clear and undamaged, and equipped with undamaged handles. It is typically made of tempered glass, plexiglass, polycarbonate, or some other clear, chemically compatible material.
- d) The exhaust flower, downflow fan, HEPA filters, front air grille, rear exhaust slot, and sash are employed to manage airflow and air quality.
- e) The interior of the biosafety cabinet including the work surface should be made of durable, corrosion-resistant, nonporous material such as stainless steel, various resins, polypropylene, or fiberglass designed to contain liquid spills and withstand harsh conditions.
- f) Biosafety cabinet electronic boards/sensors shall be maintained along with any associated fixture panel attached to the unit to prevent premature failure.
- g) Normal lighting within the biosafety cabinet (e.g. LED or LED) when turned on shall be bright enough to conduct work safely.
- h) Ultraviolet lighting will only be used for disinfection, with no personnel present during its use.

6. Access

- a) Authorized use of biosafety cabinets is restricted to those users who have access to laboratories with permission of supervisors (e.g. Principal Investigators) in these spaces.

7. Removal

- a) A device may be removed (or hibernated), if all hazards are removed, it is no longer in use, and the configuration and purpose of the room has changed requiring removal or hibernation. This would be done in consultation with EHS.

- b) If the cabinet is not removed, but hibernated
 - i. *The utilities or valve(s) must be closed or in the “off” position to stop service to the fixtures.*
 - ii. *Fixture heads must be removed or sealed.*
 - iii. *A notice for its hibernation status must be posted on the unit.*

B. Use

1. Preparation

- a) Before use of biosafety cabinet begins, the user should make sure that the unit has current certification, that airflow is appropriate with a visual test as in Step C4a below, and check for any obstructions that might impede proper airflow or exhaust within the fume hood.
- b) The principal investigator or other laboratory personnel should create a checklist of necessary items to complete their work in the biosafety cabinet. This may be part of a laboratory-specific standard operating procedure.
- c) Equipment Setup
 - i. *For Biosafety Cabinet*
 - 1) *Never enter the biosafety cabinet with your head or torso, including for equipment setup.*
 - 2) *There must not be any chemicals, hazardous materials, hazards of any kind (including hazardous energy), or other laboratory work taking place within the hood during the set-up process.*
 - 3) *Disposable absorbent pads may be used to avoid contamination of the work surface and facilitate cleanup, but they must not block the front intake grille or rear exhaust.*
 - ii. *For other equipment and supplies*
 - 1) *The external surfaces of equipment and supplies should be surface-decontaminated before placing them into the biosafety cabinet to avoid external contamination from entering the unit. This should be done all at once to minimize your arms entering and exiting while working.*
 - 2) *Include for your work in the BSC, a biohazard sharps container, biohazardous waste container (e.g. disposal stand and bag), paper towels, and wipes.*
 - 3) *Organize the work surface in the BSC by designating a clean area, work area, and dirty area, from left to right, and the dirty area being on the opposite side of the clean area, and the work area in between them. Biohazard sharps containers and small biohazard disposal stand with waste bag should be positioned in the “dirty” part of the biosafety cabinet towards the rear. Work by moving items from the clean area to the work area, and when done, place or dispose in the dirty area. Note: This placement is based on work by a right-handed person and may be reversed for that of a left-handed person.*
 - 4) *Set aerosol-generating equipment towards the back of the BSC.*

- 5) *Any medium-large equipment stored in the biosafety cabinet shall be lifted 2-3 inches from the work surface by sturdy materials such as shelving, racks, or blocks, and not obstructing grille/slot. Examples of medium-large equipment are automated liquid handlers/robotics, benchtop incubators, small centrifuges, large aspirator bottles, vacuum flasks, and vortex mixers.*
- 6) *Route any cables or tubing through access ports to avoid excessive airflow disruption or interference with the sash.*
- d) Do not overload the work surface with equipment and supplies. Only keep necessary equipment in the BSC to avoid excess airflow disruption.
- e) The drain valve from the drain tray should be fully closed prior to and during work.
- f) Review the equipment operator manuals, chemical Safety Data Sheets (SDS), and any other relevant reference material for hazardous materials prior to biosafety cabinet use.
- g) Review this SOP for appropriate BSC use and maintenance.
- h) Purge the BSC for 5 minutes prior to use.

2. Operation

Airflow is key to having a properly functioning ventilation device. Airflow to the biosafety cabinet may be affected by obstructions, external drafts to the room, infrastructure (e.g. exhaust fan, ductwork), sash positioning, and user actions and movements, so take care to follow the instructions below.

a) General Guidelines

i. Alarms & Alerts

- 1) *Check the control panel/digital display for visible alerts or alarms to ensure proper operation of the biosafety cabinet. Also, listen for audible alarms.*
- 2) *Ensure that the control panel functions appropriately and is not kept in an alarm state. Do not ignore alarms.*
- 3) *The audible alarm may be temporarily muted while investigating the cause of the alarm; the alarm will stop once the unsatisfactory condition is corrected.*
- 4) *There are several types of alarms and alerts for the biosafety cabinet:*
 - A. Airflow Alarms – activated when there is obstructed or otherwise restricted inflow or downflow.**
 - B. System Alerts – provided for maintenance needs such as new filter or lights**
 - C. Window (Sash) Position Alarm – activated when sash is too high or in wrong position.**
- 5) *If the inflow and/or downflow are too low, or there is some other unavoidable alarm state, close the sash or stop service to the unit until it can be repaired.*

- 6) *In addition to alarms and alerts, the user should observe any unusual noise or air movement to indicate proper operation of the biosafety cabinet.*

ii. Chemical Use

- 1) *Chemical use in biosafety cabinets is restricted.*
 - A. *Available biosafety cabinets on campus do not operate like fume hoods or other LEV in that they recirculate air back to the laboratory.*
 - B. *Do not use toxic, highly flammable, or volatile chemical reagents within the BSC. This may accumulate hazardous aerosols that could pass through filters and be exhausted to the breathing zone and beyond within the laboratory, causing an environment that is immediately dangerous to life and health (IDLH), as well as damage the BSC, other equipment, or the facility.*
 - C. *The current BSC type is required to be ducted to external exhaust systems or a different BSC type may be required for such work.*
- 2) *Chemical use in biosafety cabinets shall be limited to cleaners/disinfectants and those appropriate for microbiological work and samples, which release minute emissions. The cabinet should be continuously run during this chemical use to dissipate any fumes, which should be kept to a minimum.*
- 3) *Keep chemical containers used near the biosafety cabinet closed when not in use.*
- 4) *Do not store chemicals in the biosafety cabinet.*

iii. Laboratory Hygiene/Personal Protective Equipment Use

- 1) *Always use the appropriate personal protective equipment while using the biosafety cabinet, such as protective eyewear (e.g. safety glasses, splash goggles, face shield), body protection such as a laboratory coat or gown, and gloves compatible to the hazard.*
 - A. *Respiratory protection such as a particulate respirator may also be worn if the work or hazards involved require it.*
 - B. *A fit test must be done prior to any work with particulate respirators. This testing is available for workers through EHS.*
- 2) *Laboratory coats should be buttoned while gowns should be tied in the back; both garments should fit properly on the body.*
- 3) *Wear the appropriate size of glove to avoid tears and discomfort.*
- 4) *Use gloves that are appropriate for the hazard and task.*
- 5) *Gloves must be worn over the wrist of lab coat, not inside the sleeve.*
- 6) *If explosions may occur, wear a face shield in addition to other eye protection.*
- 7) *Long pants and closed-toe shoes are also appropriate when handling hazardous materials.*
- 8) *Label all hazardous materials that will be used within the biosafety cabinet.*
- 9) *Use aseptic techniques where practical to reduce splatter and aerosol generation.*

- 10) *Personnel must not bring food or drink into the laboratory, and do not place such items in the biosafety cabinet.*
- 11) *Observe recommendations found in the Laboratory Safety Manual and IBC Guide for Investigators Using Recombinant DNA in Research.*

iv. Obstructions

- 1) *Avoid opening and closing the sash rapidly. Do not use quick arm and body movements in front of or inside the hood to avoid turbulence in the cabinet.*
- 2) *The front intake grille and rear exhaust/slot (at front and towards the rear bottom, respectively) shall not be obstructed by equipment or other materials.*
- 3) *Avoid storing excess equipment in the biosafety cabinet which may disrupt airflow or inhibit working space.*
- 4) *Any medium-large equipment stored in the biosafety cabinet shall be lifted 2-3 inches from the work surface by sturdy materials such as shelving, racks, or blocks, and placed towards the back of the unit. Never open or use hazardous or infectious materials directly in front of large equipment as the fumes may be blocked from capture.*
- 5) *The interior of the unit should be uncluttered by containers, equipment, or other materials to maintain airflow and avoid excess contamination.*
 - A. *Avoid placing writing implements, clipboards, notebooks, other writing papers, and devices (e.g. phones, tablets) inside the biosafety cabinet. The items would require decontamination before being removed from its interior.*
- 6) *Keep paper, tissue, absorbent pads, vials, and other small or lightweight objects from being drawn into the exhaust features. Such materials may cause blockage and inadequate airflow.*
- 7) *Never store items on top of the biosafety cabinet. The exhaust diffuser that releases filtered air back to the room may be blocked or damaged. This diffuser also protects the exhaust HEPA filter, which may become damaged. Such items may also be within 18 inches of the ceiling, which is a fire hazard.*
- 8) *Limit traffic (pedestrian and otherwise) passing directly in front of the biosafety cabinet during use.*
- 9) *The biosafety cabinet should not be obstructed by bulky objects at its face while in operation.*

ix. Positioning

- 1) *Operational height for the sash of the biosafety cabinet sash is 8-10 inches high depending on the manufacturers' recommendations for the model. This height is denoted by the placement of its stops, where the sash sits while working. The sash should never be lifted above this height during normal operation to maintain containment and avoid alarm.*

- 2) *While using the biosafety cabinet, the user may stand or be seated, in a fashion that allows for proper ergonomic positioning and comfort as well as safety from contaminants within the BSC.*
 - A. *Their head should be positioned in front of the sash glass, always being completely above the opening of the sash while working.*
 - B. *The stool or seat used for work should be adjusted to keep the head above the sash opening in this manner, with armpits level with the bottom of the sash.*
 - C. *Arms should be bent at a 90-degree angle at the elbow while inside the BSC, with arms allowed to use armrest at front of BSC to avoid fatigue.*
 - D. *Use a foot support if legs or feet for not reach the floor or if needed for back comfort.*
 - 3) *Laboratory personnel must never enter the biosafety cabinet beyond arms during normal operation (while hazardous materials and equipment are present and active). That is, your head or upper body must never cross the plane of the sash for any reason.*
 - 4) *Position work and all apparatus/equipment at least 4-6 inches inside the front intake grille. This ensures that all work inside the biosafety cabinet is away from its sash.*
 - 5) *Minimize entering and exiting the BSC; if necessary, slowly put your arms straight in and when work is complete, slowly pull them straight out, perpendicular to the opening, to avoid airflow disruption.*
- x. *Utility Use*
- 1) *The exhaust blower setup shall be on at all times while the biosafety cabinet is in use.*
 - 2) *Avoid use of natural gas and open flames (e.g. Bunsen burner) within the biosafety cabinet as flame may damage the cabinet, materials, or other equipment, heat affects airflow, and gases are not captured by HEPA filters, leading to fire or explosion (inside BSC or within the laboratory). Substitute a hotplate for open flames.*
 - 3) *Electrical outlets should be used safely. Do not overload circuits.*
 - 4) *For chamber (LED) light use, see **Visibility** in Step B2(a)(vi) below.*
 - 5) *For UV lamp use, see Step C1(i).*
 - 6) *For the vacuum system: Use liquid disinfectant traps, HEPA filter, and/or other scrubbers to contain and collect waste solvents, vapors, or dust.*
- xi. *Visibility*
- 1) *Use the sash as a barrier and look through it during operations, not under it, to avoid exposure.*
 - 2) *The chamber (LED) light should be turned on within the biosafety cabinet for safe, active operations unless materials or equipment require that lighting is turned off for safety or functional reasons. Switch on/off by using the ON button on the control panel. Lighting may be turned off to save energy otherwise when the unit is not in use.*

3) *Monitor the biosafety cabinet when performing ongoing or reactive experiments.*

b) Work with Multiple Personnel in BSC

- i. *It is best to avoid multiple personnel working in a biosafety cabinet at once.*
- ii. *If two users are required at once to do work in a single BSC, the BSC should be a minimum of 6 feet in length at the face, and a risk assessment should be performed and documented.*

3. Normal Shutdown

- a) When work has been completed, ensure that all utilities such the chamber light, gas, or vacuum are turned off and that any electrical outlet covers are covered.
- b) Close all equipment covers and containers.
- c) Follow Step C1 to remove waste and disinfect the biosafety cabinet.
- d) Turn the unit to standby mode by closing the sash.
- e) Press and hold the ON key until the indicators are off. Always turn off the unit when it is not in use (unless it contains hazardous substances).

C. Maintenance

1. Cleaning/Disinfection

- a) To disinfect a biosafety cabinet, don the appropriate PPE for disinfection (eye protection, lab coat, gloves).
- b) Ensure that all utilities such as gas or vacuum are turned off and that any electrical outlet covers are covered.
- c) Purge the air in the unit by turning on the blower for 5-15 minutes prior to cleaning and it shall remain on during disinfection.
- d) Clean/disinfect the equipment and materials prior to removal.
 - i. *Properly disinfect, remove, and place equipment and materials in the appropriate storage areas outside the cabinet, starting with the least contaminated objects first and moving to the most contaminated.*
 - ii. *Manage stainless steel components*
 - 1) *To properly care for these components of equipment (including the BSC), use cleaners/disinfectants free of caustic agents such as chlorine, iodine, and ammonia (though diluted bleach may be used, followed by distilled/reverse osmosis (RO) water rinses twice and rinses by ethanol solution).*
 - 2) *Never use abrasive cleaners, scouring pads, or steel wool to clean these components.*
 - iii. *Disinfect, remove, and dispose waste products into the appropriate biohazard container. For example, needles and other sharps are placed in Biohazard Sharps containers and biohazardous materials may be placed into biohazard bags/boxes. Fold and remove any disposable absorbent pad used by folding from outer edges/corners of the pad and folding it inward.*

- iv. *Disinfect the exterior of biohazard waste containers before removing from the BSC.*
- v. *Use an adequate disinfectant such as 70% ethanol (or 10% bleach solution, followed by an ethanol rinse to prevent corrosion). Other disinfectants may be used if appropriate for your SOP and the equipment. Corrosion/pitting on parts creates a hospitable environment for microbes, which is to be avoided.*
- vi. *Spray disinfectant generously onto a wipe or cloth instead of directly on surfaces to avoid aerosols (from contaminant or disinfectant) and allow adequate contact time on surfaces for disinfection based on the work done.*
- e) *Clean/disinfect the interior surfaces.*
 - i. *See Step C1(d)(ii) on managing stainless steel components.*
 - ii. *Use a top-to-bottom approach. Start with the ceiling of the cabinet, then the side walls, the back wall, the interior of the sash, and lastly, the work surface. Periodically, remove the work surface and clean/disinfect the drain tray or catchment, also checking the drain valve for any accumulated liquid or debris.*
 - iii. *Use an adequate disinfectant (see Step C1(d)(ii)).*
 - iv. *Spray disinfectant onto a wipe or cloth instead of directly on surfaces to avoid aerosols (from contaminant or disinfectant).*
 - v. *Wipe down surfaces twice with distilled or RO water to remove residue.*
 - vi. *Use straight, overlapping strokes that are parallel rather than circular motion when wiping surfaces.*
 - vii. *Use of a 360-degree pivoting cleaning tool or other cleaning wand may be helpful for cleaning interior surfaces easily as they provide reach capability, angling, and make use of disposable cloths for convenience in disinfection.*
 - viii. *As a reminder, the user should never enter the biosafety cabinet with their head or torso, so this includes for the purpose of disinfection. Use an appropriate tool to complete the task.*
- f) *Purge the cabinet by allowing the cabinet to run for 3-5 minutes after disinfection to remove any remaining aerosols or particulates.*
- g) *Turn off the chamber light and blower for the unit.*
- h) *Close the sash completely.*
- i) *Ultraviolet (UV) light use for interior surfaces*
 - i. *As an additional step, the user may use the ultraviolet lamp by pressing the UV button and setting its timer to sterilize the cabinet (standard is up to an hour, but longer times may be necessary depending upon the potential contaminant).*
 - ii. *To use the UV lamp, the sash must be fully closed, the chamber light must be off, and the blower must be running or in standby mode.*
 - iii. *It is best to avoid use with equipment or samples present in the cabinet. Ultraviolet light affects plastics and some equipment components.*
 - iv. *The UV lamp must be used when the room is empty (no personnel in the laboratory during its use). Post a sign on the laboratory door warning of its use during the UV cycle.*
 - v. *Upon the end of its cycle, the user must ensure that the UV lamp is turned off.*

- vi. *Never attempt to turn on the UV while working in the cabinet, while the sash is up, or while other personnel are in the laboratory. If the UV lamp is active, opening the sash will immediately trigger its interlock, which will shut down the light.*
- vii. *UV is a supplement to chemical disinfection, not its substitute. It shall always be treated as a secondary method to decontaminate the interior surfaces of the BSC.*

Note: *The use of the ultraviolet lamp in the biosafety cabinet is allowed but is not recommended. Per NIH, "The NIH, CDC, NSF/ANSI, and the American Biological Safety Association all agree that ultraviolet (UV) lamps are not recommended nor are they necessary. NSF Standard 49, the industry testing standard for all biohazard cabinetry, does not provide any performance criteria for UV lighting and specifically states in Section 4.24.2 "UV lighting is not recommended in Class II (laminar flow) biohazard cabinetry." Numerous factors affect the activity of the germicidal effect of UV light, which require regular cleaning, maintenance, and monitoring to ensure germicidal activity. In addition, there are safety hazards associated with UV light exposure, which include cornea burns and skin cancer.*

- j) Clean/disinfectant the exterior surfaces.
 - i. *Wipe down the exterior surfaces (including the sash and control panel) of the biosafety cabinet with a saturated cloth and a mild dishwashing agent or other cleaning agent (e.g. isopropyl alcohol).*
 - ii. *Wipe the exterior surfaces with distilled or RO water to remove any residue and allow it to dry.*
 - k) Disinfect or change gloves as necessary.
 - l) Dispose of all disposable cloth/wipes and PPE such as gloves into biohazardous waste containers.
 - m) Recommended Documents
 - i. *Written log of when cleaning has been completed for a biosafety cabinet unit.*
 - ii. *Written schedule for when and by whom a biosafety cabinet unit should be cleaned.*
 - iii. *Written laboratory-specific standard operating procedure for cleaning a biosafety cabinet unit (if this SOP is not followed directly).*
2. Repair/Out-of-Specification
- a) Notify the Supervisor if biosafety cabinet or its utilities (e.g. lights, outlets, valves, pipes) are damaged, malfunctioning, or require repair in any way. They will contact Facilities Management and/or the Building Manager who may best address the issue. EHS will verify and certify that the unit is functional or use an external vendor to do so.
 - b) For biosafety cabinets that contain hazardous materials, these items must be removed, and the biosafety cabinet must be decontaminated prior to any work

repairing the unit. Decontamination will depend upon the types of materials used.

3. Equipment/Parts Maintenance

- a) EHS contracts with a third-party vendor to perform annual certifications in accordance with NSF/ANSI 49-2022: Biosafety Cabinets Design and Performance standards. In accordance with the standard, biosafety cabinets must also be recertified if moved or repaired.
- b) HEPA filters will be replaced as required, as determined by pressure drop or airflow performance during certification testing, if a filter alarm is displayed on the control panel, or if the filter is damaged. This task shall only be performed by qualified personnel wearing the appropriate PPE. Filter life will depend upon usage frequency and environment. According to the BSC manufacturer, HEPA filters generally last between 3-5 years.
- c) UV lamps will be replaced as required.

4. Testing/Certification

- a) Daily Test
 - i. *Prior to use, verify the vendor certification label for the most recent date that the biosafety cabinet was inspected; the date must be within the last 12 months.*
 - ii. *Visually test at the edge of the sash before each use by paper or anemometer. If using paper, hold at the edge of the sash; do not release the paper into the cabinet.*
 - iii. *Verify that any attached airflow meter also reads 100 fpm at a minimum prior to use.*
 - iv. *If the behavior of the airflow monitor does not match the visual test or if it is below 100 fpm when the sash is open, take the unit out of service.*
- b) Certification
 - i. *Biological safety cabinets shall be certified when installed, whenever they are moved, and at least annually.*
 - ii. *The EHS-approved vendor performs certification for biosafety cabinets upon request, typically at annual inspections.*
 - iii. *Annual certification is a requirement under the NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules.*
 - iv. *The vendor will test units for compliance with NSF/ANSI 49 including:*
 - 1) *Electrical safety in accordance with national regulations and NSF/ANSI 49*
 - 2) *Airflow conditions, such as velocity measurement in fpm*
 - 3) *Alarm tests*
 - 4) *Checking all components for possible damage*
 - 5) *Filter state, (e.g. leak tests (HEPA/ULPA) for supply and exhaust filters)*
 - 6) *Airflow smoke pattern tests*
 - 7) *Any other relevant testing, which will be noted.*
 - v. *Measurements will determine whether the unit passes inspection.*

- vi. *A vendor certification label will be affixed to the unit upon completion of the inspection. The label will be dated, completed, and initialed by the vendor.*
- vii. *If any parts or consumables are required to be replaced for the device, the vendor will notify EHS of the need for a return visit to make repairs.*
- viii. *Data will be recorded as a report, provided to EHS, and kept on file.*

D. Emergency Procedures

1. Personnel Injury/Illness/Exposure

- a) In case of emergency, call 911 or TUPD for 410-704-4444; if applicable, contact the National Poison Control Center at 1-800-222-1222.
- b) First aid kits for minor injuries are provided by your department and will be found within the facility.
- c) Eyewashes and safety showers are available for use by personnel in laboratory spaces as required.

2. Contamination/Spill

- a) In general, clean spills immediately. Do not allow spilled liquid chemicals to evaporate.
 - i. *In some cases, it may make sense to respond to a spill by pouring disinfectant (e.g. 10% bleach solution) onto the work surface and allowing it to flow to the drain tray. Allow it to remain for 10-30 minutes and then evacuate the liquid through the open drain valve by attaching tubing to the valve and emptying it into an appropriate waste container.*
- b) In case of major contamination or spill (e.g. immediately dangerous to life or health, cannot be contained to the room), immediately exit the facility and do not re-enter the contaminated environment until the condition can be corrected. If spilled within the biosafety cabinet, close the sash prior to leaving.
- c) Warn others in the laboratory of the emergency on your way out of the facility.
- d) Contact EHS at 410-704-2949.
- e) Report the nature/hazard of the spill (i.e. what chemical or hazardous material used, volume or mode of contamination [airborne, toxic, etc.]), and any other pertinent information.

3. Facility/Equipment

- a) Fire/Emergency Evacuation
 - i. *In case of fire or required evacuation (e.g. natural gas leak)*
 - 1) *Stop work immediately and evacuate the facility, shutting down operations on the way out of the laboratory.*
 - 2) *Warn others in the laboratory of the emergency on your way out of the facility and activate the fire alarm.*
 - ii. *If a fire occurs inside the biosafety cabinet*
 - 1) *Stop work immediately.*
 - 2) *Immediately close the sash and evacuate the laboratory.*

- 3) *Warn others in the laboratory of the emergency on your way out of the facility and activate the fire alarm.*
- 4) *From a safe area, contact 911/TUPD to report the type of fire (e.g. chemical fire).*
- b) Facility Failure
 - i. *In the event of a facility failure or malfunction (e.g. power outage, HVAC failure, water outage) the Continuity of Operations Procedures for the facility should be followed.*
 - ii. *Contact Facilities Management at 410-704-2481 for the following:*
 - 1) *Natural gas leak, water leaks/flooding, HVAC, telecommunications, electrical, or any other mechanical/infrastructural issues.*
- c) Equipment Failure
 - i. *If you observe defective or overheating equipment, shut off the equipment, disconnect it, close the sash, and report the problem to your Supervisor.*
 - ii. *If the alarm sounds or the monitor lights indicate low flow while working, work should be stopped, equipment turned off, and the sash lowered. Lab personnel should leave the area if there is an immediately dangerous to life and health emergency, and notify other individuals in the area to exit.*

E. Training

1. Personnel who may use a biosafety cabinet must be trained in its proper operation prior to use. Users will follow laboratory training and procedures for how to use specific equipment within biosafety cabinets at all times.
2. Biosafety cabinet users will follow this standard operating procedure.

Resources

A. ANSI

1. ANSI/AIHA/ASSP Z9.5-2002 Laboratory Ventilation
2. [NSF/ANSI 49-2024 Biosafety Cabinets Design and Performance](#)

B. CDC-NIH

1. [Biosafety in Microbiological and Biomedical Laboratories \(BMBL\), 6th Edition](#)
2. [Fundamentals of Working Safely in a Biological Safety Cabinet \(BSC\)](#)
3. [Biological Safety Cabinet \(BSC\) - Cleaning: Below the Deck \(Work Surface\)](#)

C. OSHA

1. [Biosafety Cabinets](#)
2. [Bloodborne Pathogens](#)
3. [Occupational Exposure to Hazardous Chemicals in Laboratories & Appendix A – National Research Council Recommendations Concerning Chemical Hygiene in Laboratories](#)

D. Environmental Health & Safety

For issues with equipment or general inquiries, contact EHS by emailing safety@towson.edu or by calling the Environmental Health & Safety (EHS) office at 410-704-2949.

Appendix A: Vendor Certification Label for Biosafety Cabinets

BSC Testing Vendor www.bsctestingvendor.com 1-800-555-5555 1234 Main Street, Towson, MD 21234	
DATE TESTED: <u>14 JAN 2026</u>	
MCI NUMBER: <u>DRH54579202A</u>	
SERIAL NUMBER: <u>3005156721</u>	
DUE FOR RETEST: <u>31 JAN 2027</u>	
TESTED BY: <u>JOHN TESTER</u>	
<u>1375</u>	<u>51-57 S277</u>
OTHER: <u>Inflow: 108</u>	
TEST REPORT #	
1034255900	